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Taeniid species in Hungary (Cestoda: Taeniidae). II. Larval stages of taeniids parasitizing rodents and lagomorphs

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ABSTRACT. Examination of 6654 rodent and 408 lagomorph intermediate hosts for taeniid larvae resulted in the occurrence of nine species: Taenia crassiceps (Zeder, 1800), T. martis (Zeder, 1803), T. pisiformis (Bloch, 1780), T. tenuicollis Rudolphi, 1819, Multiceps serialis (Gervais, 1874), Hydatigera taeniaeformis (Batsch, 1786), Tetratirotaenia polyacantha (Leuckart, 1856), Cladotaenia globifera (Batsch, 1786), C. circi Yamaguti, 1935.

INTRODUCTION

Faunistical and systematical evaluation, together with notes on ecological and veterinary aspects, of Taeniidae species infesting vertebrates in Hungary have been published by MURAI & TENORA (1973), NECHAY (1973), MURAI, SUGÁR & HŐNICH (1975), MURAI & SUGÁR (1976, 1979). In this paper I report faunistical data of larval forms of taeniids found in rodents and lagomorphs and discuss the systematical status of these species.

MATERIAL AND METHODS

A total of 7062 rodents and lagomorphs have been captured and examined for helminths in the course of field work between 1965-1980 by staff of the Parasitological collection of the Zoological Department, Hungarian Natural History Museum: I. MATSKÁSI, F. MÉSZÁROS, Éva MURAI, Aranka STIRLING, I. SZABÓ, Etelka VAJDA, as well as by A. DEMETER, G. NECHAY, G. TOPÁL and L. ZOMBORI. Leporids were collected by L. SUGÁR and P. SZÉKI. The material from Ondatra zibethicus was presented by B. EDELÉNYI and O. SEY. The authoress thanks all for their kind cooperation and assistance.

Larval stages of taeniids were recovered from the following intermediate host species: 159 Cricetus cricetus (Linnaeus, 1758), 298 Ondatra zibethicus (Linnaeus, 1758), 561 Clethrionomys glareolus (Schreber, 1780), 73 Pitymys subterraneus (DeSelys-Longchamps, 1836), 2610 Microtus arvalis (Pallas, 1779), 12 Microtus oeconomus (Pallas, 1776), 12 Microtus agrestis (Linnaeus, 1761), 1625 Apodemus flavicollis (Melchior, 1834), 202 Apodemus sylvaticus (Linnaeus, 1758), 259 Apodemus microps Kratochvil & Rosicky, 1952, 199 Apodemus agrarius (Pallas, 1771), 365 Mus musculus spicilegus Petényi, 1832, 14 Rattus norvegicus (Berkenhout, 1769), 382 Lepus europaeus (Pallas, 1778), 26 Oryctolagus cuniculus (Linnaeus, 1758). Cysticerci were not found in the following rodents: 9 Spalax leucodon (Nordman, 1840), 2 Arvicola terrestris (Linnaeus, 1758), 158 Micromys minutus (Pallas, 1778), 12 Sciurus vulgaris Linnaeus, 1758, 70 Citellus citellus (Linnaeus, 1766), 14 Glis glis (Linnaeus, 1766). For the infection rates of larval taeniids in the intermediate hosts, see Table 1.

The Taeniidae larvae were fixed and preserved in 10% hot formalin. The rostellar hooks were studied in Berlese medium. The over 800 preparations of this study are deposited in the Zoological Department of the Hungarian Natural History Museum, Budapest.

Table 1. Extensity of larval taeniids in small mammals in Hungary

Small mammal species examined	No. of small mammals examined	No. of small mammals infested	Taenia crassiceps	Taenia martis	Taenia pisiformis	Taenia tenuicollis	Multiceps serialis	Hydatigera taeniaeformis	Tetratirotaenia polyacantha	Cladotaenia globifera	Cladotaenia circi
LAGOMORPHA											
Leporidae											
Lepus europaeus	382	72	-	-	67	-	5	-	-	-	-
Oryctolagus cuniculus	26	16	-	-	16	-	-	-	-	-	-
RODENTIA											
Cricetidae											
Cricetus cricetus	159	11	-	-	-	11	-	-	-	-	-
Spalacidae											
Spalax leucodon	9	0	-	-	-	-	-	-	-	-	-
Microtidae											
Ondatra zibethicus	298	74	1	-	-	-	-	72	1	-	-
Clethrionomys glareolus	561	46	-	1	-	38	-	2	2	2	1
Arvicola terrestris	2	0	-	-	-	-	-	-	-	-	-
Pitymys subterraneus	73	23	-	-	-	15	-	8	-	-	-
Microtus arvalis	2610	207	13	-	-	44	-	147	2	-	1
Microtus agrestis	12	1	-	-	-	1	-	-	-	-	-
Microtus oeconomus	12	2	-	-	-	2	-	-	-	-	-
Muridae											
Micromys minutus	158	0	-	-	-	-	-	-	-	-	-
Apodemus flavicollis	1625	84	-	4	-	1	-	64	-	16	-
Apodemus sylvaticus	202	4	-	-	-	-	-	4	-	-	-
Apodemus microps	259	20	-	-	-	-	-	16	-	4	-
Apodemus agrarius	199	1	-	-	-	-	-	-	-	1	-
Mus musculus spicilegus	365	41	-	-	-	-	-	41	-	-	-
Rattus norvegicus	14	1	-	-	-	-	-	1	-	-	-
Sciuridae											
Sciurus vulgaris	12	0	-	-	-	-	-	-	-	-	-
Citellus citellus	70	0	-	-	-	-	-	-	-	-	-
Gliridae											
Glis glis	14	0	-	-	-	-	-	-	-	-	-
Total:	7062	604	14	5	83	112	5	355	5	23	2

Two comprehensive studies dealing with the systematics and taxonomy of the cestode family Taeniidae have been published recently (see ABULADZE, 1964, VERSTER, 1969). The authors differ in their opinion on taxa of generic rank. I have followed in this paper ABULADZE's systematical and taxonomical differentiation.

RESULTS

Larval stages of seven Taeniidae species were found in rodents: Taenia crassiceps (Zeder, 1800), T. martis (Zeder, 1803), T. tenuicollis (Rudolphi, 1819), Hydatigera taeniaeformis (Batsch, 1786), Tetratirotaenia polyacantha (Leuckart, 1856), Cladotaenia circi Yamaguti, 1935, C. globifera (Batsch, 1786).

Lagomorphs are intermediate hosts for two taeniids: Taenia pisiformis (Bloch, 1786) and Multiceps serialis (Gervais, 1874).

I present in the following section the faunistical data, the short characterization of larval forms and notes on systematical status and the nomenclature of these species. Hungarian data for the adult stage of Taeniidae will be published in a separate communication.

The material of our examination was collected in different parts of Hungary. Table 2 contains the number of rodent, and Table 3 that of the lagomorph intermediate hosts examined in various counties of Hungary, and includes the extensity of larval taeniids in these mammals.

1. Taenia crassiceps (Zeder, 1800) Rudolphi, 1810

Name of larva: Cysticercus longicollis Rudolphi, 1819.

Intermediate hosts: Ondatra zibethicus and Microtus arvalis[+]. - Localization: abdominal and thoracic cavities, subcutaneous lacunae. - Extensity: 0.33% in O. zibethicus and 0.5% in M. arvalis. - Intensity: 3 to 4300 cysticerci.

Collection data of the infested intermediate hosts:

Ondatra zibethicus - County Veszprém: Ábrahámhegy 24/04/75 = 1 case.

Microtus arvalis - County Bács-Kiskun: Kunadacs 12/04/80 (1)[++]; County Szabolcs-Szatmár: Tiszabercel 12/06/72 (1); County Vas: Bozsok 04/03/75 (1), 15/04/75 (2), Bük 20/11/66 (1), 26/07/72 (1), 24/08/73 (1), 22/02/74 (1), 15/08/74 (1), Tanakajd 03/10/74 (2), Tömörd 30/08/68 (1) = 13 cases.

Characterization of larval T. crassiceps

In the specimens infested with C. longicollis, cysticerci were found in intraperitoneal, extraperitoneal and subcutaneous positions. The mass of cysticerci of various developmental stages were enclosed by a thin membrane of connective tissue, or they migrated freely between the organs of the abdominal cavity or in the thoracic cavity (Fig. 1). The maximum number of cysticerci counted in M. arvalis was 1800, the same in O. zibethicus was 4300. The majority of oval or globular cysticerci vary in size from 2 to 4 mm and contain invaginated scoleces. In many of the cysticerci, exogenous larval multiplication by budding may be observed at the abscolex pole. In young cysticerci (1.5 mm in diameter) rostella are composed of undeveloped hooks. Some larvae 2x3 mm in size have everted scolex like that of the adult helminths (full cysticercus) and have a small bladder opposite to the scolex. Older cysticerci are characterized by large number of calcareous bodies. The diameter of larval scolex vary from 0.65 to 0.75 mm, that of the rostellum from 0.38 to 0.42, those of the four suckers from 0.24 to 0.26 mm. Rostellar hooks in two rows, 28-35 in number; the larger vary in length from 0.180 to 0.196 mm, the smaller from 0.135 to 0.156 mm. Figures 8 and 10 illustrate the shape of the fully developed hooks and Figure 9 that of the young rostellar hooks.

Infestation by larval T. crassiceps in the examined small mammal material was with low extensity. This is surprising, since studies on the definitive host, the red fox have shown that about 25% are infested with T. crassiceps (unpublished data).

[+] TENORA (1976b) reported C. crassiceps in Pitymys subterraneus from the Bakony mountains (County Veszprém: Szentgál), but unfortunately the specimens are no longer available.

[++] Number of the infested intermediate host specimens.

Table 2. Distribution of rodents examined for larval taeniids in Hungary in various counties

Intermediate hosts and localities	Number of rodents examined	Number of specimens infested						
		Taenia crassiceps	T. martis	T. tenuicollis	Hydatigera taenlaeformis	Tetratirotaenia polyacantha	Cladotaenia globifera	C. circi
CRICETIDAE								
Cricetus cricetus								
Bács-Kiskun	9	-	-	-	-	-	-	-
Fejér	1	-	-	-	-	-	-	-
Győr-Sopron	1	-	-	-	-	-	-	-
Hajdú-Bihar	50	-	-	3	-	-	-	-
Heves	21	-	-	1	-	-	-	-
Pest	3	-	-	-	-	-	-	-
Szabolcs-Szatmár	65	-	-	6	-	-	-	-
Szolnok	8	-	-	1	-	-	-	-
Subtotal	159	-	-	11	-	-	-	-
MICROTIDAE								
Ondatra zibethicus								
Baranya	12	-	-	-	1	-	-	-
Bács-Kiskun	2	-	-	-	-	-	-	-
Békés	61	-	-	-	18	-	-	-
Győr-Sopron	221	-	-	-	51	1	-	-
Pest	1	-	-	-	1	-	-	-
Veszprém	1	1	-	-	1	-	-	-
Subtotal	298	1	-	-	72	-	-	-
Clethrionomys glareolus								
Baranya	16	-	-	-	-	-	-	-
Bács-Kiskun	1	-	-	-	-	-	-	-
Borsod-Abaúj-Zemplén	3	-	-	-	-	1	-	-
Fejér	5	-	-	-	-	-	-	-
Győr-Sopron	79	-	-	8	-	-	1	-
Heves	6	-	-	-	1	-	-	-
Nógrád	1	-	-	-	-	-	-	-
Pest	30	-	1	1	-	-	-	-
Somogy	78	-	-	10	-	-	-	-
Szabolcs-Szatmár	3	-	-	-	-	-	-	-
Tolna	2	-	-	-	-	-	-	-
Vas	56	-	-	6	-	-	-	1
Veszprém	246	-	-	12	1	-	-	-
Zala	34	-	-	1	-	1	1	-
Subtotal	561	-	1	38	2	2	2	1

(Table 2 continued 1)

Intermediate hosts and localities	Number of rodents examined	Number of specimens infested						
		Taenia crassiceps	T. martis	T. tenuicollis	Hydatigera taeniaeformis	Tetratirotaenia polyacantha	Cladotaenia globifera	C. circi
Pitymys subterraneus								
Baranya	6	-	-	-	-	-	-	-
Fejér	5	-	-	-	-	-	-	-
Győr-Sopron	18	-	-	8	2	-	-	-
Komárom	1	-	-	-	1	-	-	-
Pest	13	-	-	2	-	-	-	-
Somogy	2	-	-	1	-	-	-	-
Vas	3	-	-	1	-	-	-	-
Veszprém	24	-	-	3	5	-	-	-
Zala	1	-	-	-	-	-	-	-
Subtotal	73	-	-	15	8	-	-	-
Microtus arvalis								
Bács-Kiskun	287	1	-	7	11	-	-	-
Fejér	41	-	-	-	-	-	-	-
Győr-Sopron	25	-	-	-	-	-	-	-
Hajdú-Bihar	39	-	-	1	1	-	-	-
Pest	277	-	-	3	16	-	-	-
Szabolcs-Szatmár	8	1	-	-	-	-	-	-
Vas	1693	11	-	32	116	2	-	1
Veszprém	223	-	-	1	3	-	-	-
Zala	17	-	-	-	-	-	-	-
Subtotal	2610	13	-	44	147	2	-	1
Microtus agrestis								
Vas	5	-	-	1	-	-	-	-
Zala	7	-	-	-	-	-	-	-
Subtotal	12	-	-	1	-	-	-	-
Microtus oeconomus méhelyi								
Győr-Sopron	3	-	-	2	-	-	-	-
Zala	9	-	-	-	-	-	-	-
Subtotal	12	-	-	2	-	-	-	-
MURIDAE								
Apodemus flavicollis								
Baranya	74	-	-	-	1	-	-	-
Bács-Kiskun	51	-	-	-	1	-	-	-
Borsod-Abaúj-Zemplén	5	-	-	-	-	-	-	-
Fejér	67	-	-	-	3	-	-	-
Győr-Sopron	240	-	-	1	4	-	-	-
Hajdú-Bihar	103	-	-	-	7	-	1	-
Heves	41	-	-	-	4	-	-	-
Komárom	15	-	-	-	3	-	-	-
Nógrád	1	-	-	-	-	-	-	-

(Table 2 continued 2)

Intermediate hosts and localities	Number of rodents examined	Number of specimens infested						
		Taenia crassiceps	T. martis	T. tenuicollis	Hydatigera taeniaeformis	Tetratirotaenia polyacantha	Cladotaenia globifera	C. circi
Pest	182	-	4	-	11	-	7	-
Somogy	241	-	-	-	5	-	3	-
Szabolcs-Szatmár	13	-	-	-	-	-	-	-
Tolna	28	-	-	-	2	-	-	-
Vas	79	-	-	-	2	-	3	-
Veszprém	459	-	-	-	19	-	2	-
Zala	27	-	-	-	2	-	-	-
Subtotal	1625	-	4	1	64	-	16	-
Apodemus sylvaticus								
Baranya	11	-	-	-	-	-	-	-
Bács-Kiskun	40	-	-	-	-	-	-	-
Fejér	11	-	-	-	-	-	-	-
Győr-Sopron	28	-	-	-	-	-	-	-
Hajdú-Bihar	18	-	-	-	2	-	-	-
Pest	12	-	-	-	1	-	-	-
Vas	20	-	-	-	-	-	-	-
Veszprém	22	-	-	-	-	-	-	-
Zala	40	-	-	-	1	-	-	-
Subtotal	202	-	-	-	4	-	-	-
Apodemus microps								
Hajdú-Bihar	37	-	-	-	-	-	-	-
Pest	222	-	-	-	16	-	4	-
Subtotal	259	-	-	-	16	-	4	-
Apodemus agrarius								
Baranya	21	-	-	-	-	-	-	-
Hajdú-Bihar	81	-	-	-	-	-	-	-
Pest	3	-	-	-	-	-	-	-
Somogy	74	-	-	-	-	-	1	-
Szabolcs-Szatmár	15	-	-	-	-	-	-	-
Zala	5	-	-	-	-	-	-	-
Subtotal	199	-	-	-	-	-	1	-
Mus musculus spicilegus								
Baranya	10	-	-	-	-	-	-	-
Bács-Kiskun	117	-	-	-	7	-	-	-
Fejér	18	-	-	-	-	-	-	-
Győr-Sopron	3	-	-	-	-	-	-	-
Hajdú-Bihar	10	-	-	-	1	-	-	-
Pest	133	-	-	-	26	-	-	-
Vas	9	-	-	-	2	-	-	-

(Table 2 continued 3)

Intermediate hosts and localities	Number of rodents examined	Number of specimens infested						
		Taenia crassiceps	T. martis	T. tenuicollis	Hydatigera taeniaeformis	Tetratirotaenia polyacantha	Cladotaenia globifera	C. circi
Szabolcs-Szatmár	18	-	-	-	1	-	-	-
Veszprém	47	-	-	-	4	-	-	-
Subtotal	365	-	-	-	41	-	-	-
Rattus norvegicus								
Fejér	2	-	-	-	-	-	-	-
Győr-Sopron	1	-	-	-	1	-	-	-
Pest	9	-	-	-	-	-	-	-
Szabolcs-Szatmár	2	-	-	-	-	-	-	-
Subtotal	14	-	-	-	1	-	-	-
Total	6289	14	5	112	355	5	23	2

Note. The morphology of the larvae corresponds with the descriptions given in the literature (BAER, 1952, FREEMAN, 1962, FREEMAN et al., 1973, ABULADZE, 1964).

2. Taenia martis (Zeder, 1803)

Name of larva: Cysticercus martis Zeder, 1803.

Intermediate hosts: Clethrionomys glareolus and Apodemus flavicollis. - Localization: thoracic cavity. - Extensity: 0.18% in C. glareolus, and 0.25% in A. flavicollis. - Intensity: 1-5 specimens.

Collection data of the infested intermediate hosts:
Clethrionomys glareolus - County Pest: Bernecebaráti, Deszkáspuszta 08/04/67 = 1 case.
Apodemus flavicollis - County Pest: Bernecebaráti, Deszkáspuszta 29/03/63 (1), 05/04/64 (1), 03/04/67 (2) = 4 cases.

Characterization of Cysticercus martis

The non-encysted larvae were found situated freely in the thoracic and sometimes in the abdominal cavity of the intermediate hosts. The larvae, which possessed fully developed rostellar hooks, were elongate in shape with the anterior end pseudosegmented. The posterior end is attenuated (Fig. 3). The colour of the larvae is whitish, and vary in size from 3x10 to 6x30 mm. The thin-walled young larvae 2-5 mm in diameter are globuler, typical cysticerci without fibrous capsule. The invaginated scolex is situated in the anterior third of the larva, 1 mm in size. The rostellum range in diameter from 0.30 to 0.32 mm, the suckers from 0.24 to 0.26 mm. The rostellum is armed with two rows of characteristically shaped hooks 28-33 in number. The larger hooks vary in length from 0.210 to 0.218 mm, the smaller measure 0.156 to 0.162 mm (Figs. 11, 12).

Adult specimens of Taenia martis were found in a Martes foina definitive host collected in the Mátra mountains (County Heves).

Note. FREEMAN (1956) clarified the taxonomical problems of Taenia martis Zeder, 1803. ABULADZE (1964), however, accepted the validity of the taxon Taenia intermedia Rudolphi, 1810 for this species. As the name T. martis is now generally used, we have applied this name previously (MURAI & TENORA, 1973).

Cysticercus martis found in the Hungarian material corresponds in all aspects with the larvae from Switzerland described by WAHL (1967), only the upper limit of length measurements is apparently smaller (50 mm in WAHL and 30 mm in this sutdy). It must be noted here that a regrettable misprint occurred in MURAI & TENORA (1973): the maximum body length of the larvae was given as 60 mm. No such large specimens have been found in the material.

All larvae were monocephalic. Only semi-developed hooks were found in a young larva 2 mm in diameter (Fig. 13). One globular cysticercus 5 mm in diameter possessed rostellar hooks characteristic for the species. It is assumed that the larvae continually grow in size after the development of the scolex, so a size of 50 mm may eventually be reached.

3. Taenia pisiformis (Bloch, 1780) Gmelin, 1790

Name of larva: Cysticercus pisiformis (Bloch, 1780).

Intermediate hosts: Lepus europaeus, Oryctolagus cuniculus. - Localization: Liver and body cavity. - Extensity: 17.3% in Lepus europaeus, and 61% in Oryctolagus cuniculus examined. - Intensity: 3-350 specimens.

Localities and collection data of the infested leporids:

Lepus europaeus - County Bács-Kiskun: Bugac 01/02/66 (1), Kunbaja 08/02/74 (3), Mélykút 22/11/72 (1), Tompa 10/11/73 (1); County Békés: Füzesgyarmat 20/06/73 (2); County Fejér: Martonvásár 11/12/74 (1); County Győr-Sopron: Mosonmagyaróvár 19/06/73 (1); County Hajdú-Bihar: Debrecen 21/01/65 (1), Újszentmargita 14/09/75 (1); County Heves: Adács 04/09/73 (1), Gyöngyös 22/01/73 (2), 07/03/73/ (1), 25/04/73 (1), 25/10/73 (1), 28/12/73 (1), Hatvan 22/12/72 (4), 22/01/73 (1), 22/02/73 (2), 26/03/73 (1), 25/04/73 (1), 30/05/73 (1), 05/09/73 (1), 03/10/73 (2), 28/11/73 (1), 26/12/73 (1), Hort 22/12/72 (1), 28/03/73 (1), 30/05/73 (3), 03/07/73 (2), 04/09/73 (1), 28/11/73 (1), 27/12/73 (2), Vámosgyörk 28/03/73 (2), 25/04/73 (2), 30/05/73 (1), 17/07/73 (2); County Pest: Gödöllő 15/11/72 (1), Isaszeg

Table 3. Distribution of leporids examined for larval taeniids in Hungary in various counties

Intermediate hosts and localities	Number of leporids examined	Number of specimens infested	
		Taenia pisiformis	Multiceps serialis
LEPORIDAE			
Lepus europaeus			
Bács-Kiskun	20	6	2
Békés	10	2	-
Csongrád	1	-	-
Fejér	9	1	-
Győr-Sopron	8	1	-
Hajdú-Bihar	4	2	-
Heves	247	41	-
Pest	39	3	2
Somogy	6	-	-
Szabolcs-Szatmár	11	5	-
Szolnok	26	5	1
Veszprém	1	1	-
Subtotal	382	67	5
Oryctolagus cuniculus			
Győr-Sopron	1	-	-
Pest	25	16	-
Subtotal	26	16	-
Total	408	83	5

06/05/75 (1), 28/11/76 (1); County Szabolcs-Szatmár: Dombrád 29/03/73 (2), Kemecse 27/05/73 (2), Nyirbéltek 21/10/72 (1); County Szolnok: Poroszló 11/11/72 (5); County Veszprém: Farkasgyepü 23/09/76 (1) = 67 cases.

Oryctolagus cuniculus - County Pest: Alsópakony 05/10/79 (2), Bugyi 04/05/78 (2), Felsőpakony 05/03/79 (1), Gödöllő 24/07/79 (1), Isaszeg 29/09/73 (2), 29/05/74 (1), Kerepes 30/10/73 (1), Ócsa 21/05/80 (2), Szada 12/11/77 (2), 20/01/78 (1), Zsámbék 24/01/76 (1) = 16 cases.

Characterization of Cysticercus pisiformis

A frequent parasite of logomorphs situated on the liver surface and in body cavities. Most commonly settles on the mesentery of the abdominal cavity. In one instance a C. pisiformis larva was found in lung, but those had deformed hooks (Fig. 16). In massive infestation the mass of pea-sized cysticerci, resemling grapes, may fill the whole abdominal cavity.

The host-cysts are transparent or yellowish-white, about the size of 5x5 to 7x12 mm in diameter, globular to ovoid (Fig. 7). The cyst is entirely filled with the bladderworm that is full of a clear liquid. Diameter of the scolex and neck region 2 mm, that of the rostellum 0.5 mm. The diameter of the four suckers is 0.3 mm. It possesses a double circle of 38-42 rostellar hooks; length of large hooks 0.224-0.252 mm, of the small ones 0.131-0.156 mm. The shape of the hooks is illustrated in Figures 14-15.

This species is of veterinary importance for young hares: the larva penetrate the liver during invasion, causing acute inflammation, which may result in the death of the young (SUGÁR, MURAI & MÉSZÁROS, 1978).

Definitive hosts of Taenia pisiformis are stray dogs and foxex. 50% of stray dogs are infected with it in Hungary (MURAI & SUGÁR, 1976).

4. Taenia tenuicollis Rudolphi, 1819

Name of larva: Cysticercus talpae Rudolphi, 1819.

Intermediate hosts: Cricetus cricetus, Clethrionomys glareolus, Pitymys subterraneus, Microtus arvalis, M. agrestis, M. oeconomus, Apodemus flavicollis. - Localization in the intermediate hosts: liver tissue. - Extensity: 6.9% in Cricetus cricetus, 6.7% in Clethrionomys glareolus, 20.5% in Pitymys subterraneus, 1.7% in Microtus arvalis, 8.3% in M. agrestis, 16.6% in M. oeconomus, 0.06% in Apodemus flavicollis. - Intensity: 1-20 cysticercus.

Collection data of intermediate hosts infested with Cysticercus talpae:

Cricetus cricetus - County Hajdú-Bihar: Kaba 07/05/76 (2), Mikepércs 07/05/76 (1); County Heves: Mezőkövesd 15/09/72 (1); County Szabolcs-Szatmár: Tiszavasvári 16/05/72 (6); County Szolnok: Kenderes 19/05/75 (1) = 11 cases.

Clethrionomys glareolus - County Győr-Sopron: Brennbergbánya 27/09/71 (3), 25/04/72 (1), 28/04/73 (1), Sopron, Tómalom 22/09/71 (3); County Pest: Pilisszentlászló 21/05/71 (1); County Somogy: Mike, halastó 13/10/77 (2), Somogycsicsó, Ágneslak 17/07/75 (3), 11/11/75 (4), 13/10/77 (1); County Vas: Őriszentpéter 21/06/67 (6); County Veszprém: Balatoncsicsó 28/11/68 (1), 04/11/71 (2), Farkasgyepü 30/07/76 (1), 02/11/77 (2), Nagyvázsony 04/11/71 (2), Németbánya 09/08/73 (1), 28/07/76 (1), 28/10/79 (1), Szentgál 15/07/52 (1); County Zala: Fityeház 25/04/67 (1) = 38 cases.

Pitymys subterraneus - County Győr-Sopron: Brennbergbánya 22/09/71 (1), Sopron, Szárhalom-Forest 28/08/70 (1), Sopron, Tómalom 22/04/71 (4), 21/09/71 (1), 25/10/74 (1); County Pest: Pilisborosjenő 24/08/71 (2); County Somogy: Somogycsicsó, Ágneslak 14/05/75 (1); County Vas: Bük 05/02/75 (1); County Veszprém: Németbánya 11/08/73 (3) = 15 cases.

Microtus arvalis - County Bács-Kiskun: Dunapataj, Szelidi-tó 02/11/80 (1), 09/11/80 (1), Fülöpháza, Kondor-tó 17/03/80 (1), 20/03/80 (1), Kunadacs 29/02/80 (1), 24/03/80 (1), 30/03/80 (1), Orgovány 28/09/71 (1); County Hajdú-Bihar: Nagyiván 07/09/76 (1); County Pest: Gödöllő, Babatpuszta 27/10/78 (3); County Vas: Bozsok 28/02/73 (1), 23/03/73 (1), 23/08/73 (3), 24/07/74 (2), Bük 27/02/73 (1), 22/03/73 (1), 25/07/73 (1), 24/08/73 (1), 19/09/73 (8), 22/02/74 (1), 24/07/74 (2), 17/10/74 (4), 20/11/74 (1), Jánosháza 05/11/67 (1), Meggyespuszta 13/08/68 (1), Tanakajd 01/11/67 (1), 13/09/74 (1); County Veszprém: Nemesvámos 16/10/75 (1) = 44 cases.

Microtus agrestis - County Vas: Őriszentpéter 23/06/76 = 1 case.

Microtus oeconomus - County Győr-Sopron: Sopron, Tómalom 24/10/74 = 2 cases.

Apodemus flavicollis - County Győr-Sopron: Sopron, Szárhalom-Forest 27/08/70 = 1 case.

Characterization of the larval Taenia tenuicollis

Cysticercus talpae were found in the liver of 112 specimens representing 7 species of intermediate hosts (about 150 preparations were specially made). The shape of the cyst is oval to globular (Fig. 6), usually situated on the surface of the liver (at massive infestation also in the deeper layers). The cyst is translucent, with the cysticercus freely situated in it. Diameter of the host-cysts varied from 1 to 3 mm, the oval-shaped cysticerci varied in size from 0.8 to 2.0 mm. The host-cyst contains one cysticercus only, which has an invaginated scolex. Young larvae contain few, but older larvae posses a larger number of calcareous bodies. Diameter of the scolex is 0.3 mm, that of the rostellum vary from 0.075 to 0.082 mm, that of the suckers from 0.120 to 0.140 mm. The rostellum is arranged in two rows of hooks which are very similar and only slightly different in size. The number of hook vary from 43 to 58. The length of the large hooks vary from 0.020 to 0.023 mm (sometimes 0.025 mm), those of the small ones from 0.018 to 0.020 mm. The base of the hooks is 1-2 µm shorter than its length (Figs. 17-19).

Figs. 1-7. Larval forms of taeniids parasitizing rodents and lagomorphs: 1 = Cysticerci of T. crassiceps from M. arvalis surrounded by membranes of the connective tissue. 2 = Coenurus serialis from the tigh musculature of L. europaeus. 3 = Cysticercus martis from A. flavicollis. 4 = Armatetrathyridium polyacantha from C. glareolus. 5 = Heavy infestation of the liver of A. flavicollis by Cladothyridium globifera. 6 = A cysticercus of T. tenuicollis on the surface of the liver of M. arvalis. 7 = Cysticercus pisiformis from L. europaeus (Figs. 2 and 7 cysts in natural condition, photo by L. SUGÁR; the other cysticerci preserved in formalin, photo by É.MURAI)

Figs. 8-10. Rostellar hooks of larval T. crassiceps: 8 = Hooks of a whole scolex from M. arvalis. 9 = Hooks of a young cysticercus. 10 = Shape of the fully developed hooks

Figs. 11-13. Rostellar hooks of larval T. martis: 11 = Hooks of a whole scolex from A. flavicollis. 12 = Shape of the fully developed hooks. 13 = Rostellar hooks of a young cysticercus

Figs. 14-16. Rostellar hooks of Cysticercus pisiformis: 14 = A whole hook-crown from L. europaeus. 15 = Shape of the hooks in natural position. 16 = Rostellum with hooks deformed, from the lung of L. europaeus

Figs. 17-19. Rostellar hooks of larval T. tenuicollis: 17 = Hooks in natural position from the intermediate host M. arvalis. 18 = A whole hook-crown from C. glareolus. 19 = Shape of the hooks

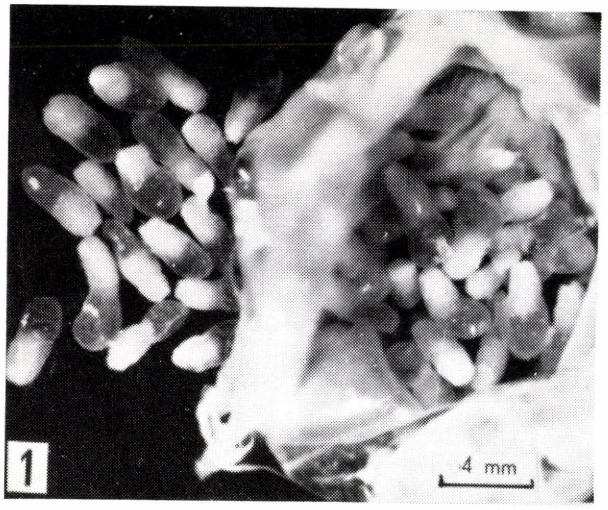
Figs. 20-21. Rostellar hooks of Coenurus serialis: 20 = Hooks of a whole scolex from L. europaeus. 21 = Shape of the hooks

Figs. 22-23. Rostellar hooks of Armatetrathyridium polyacantha: 22 = Shape of the fully developed hooks. 23 = Hook-crown of a whole scolex from C. glareolus

Figs. 24-26. Cladothyridium globifera: 24 = Situation of Cladothyridia in the liver tissue of A. flavicollis. 25 = Hook-crown of C. globifera. 26 = Shape of the larval hooks

Figs. 27-29. Cladothyridium circi: 27 = Hook-crown of C. circi from M. arvalis. 28 = C. circi without host-cyst. 29 = Shape of the rostellar hooks

Figs. 30-41. Rostellar hooks of Hydatigera taeniaeformis under the development of the Strobilocercus larva: 30 = Hook-crown of the fully developed Strobilocercus. 31-33 = Awl-shaped hook formations of the very young larvae. 34-36 = Sickle-shaped hooks of young larvae. 37 = Developing hooks with guard. 38-40 = Developing hooks with handle and guard. 41 = Shape of the fully developed hooks (Fig. 24 coloured with Carmine hydrochloric; all the other hooks in Berlese solution, photo by É. MURAI)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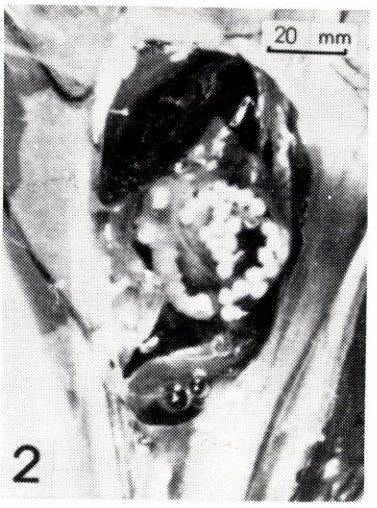
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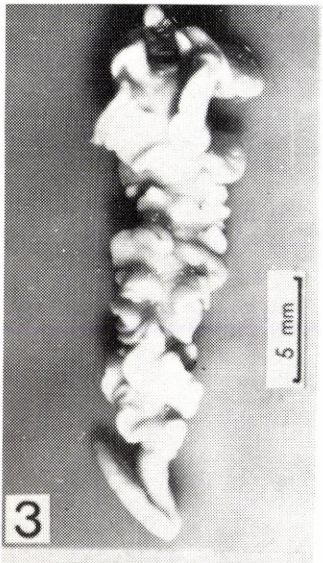
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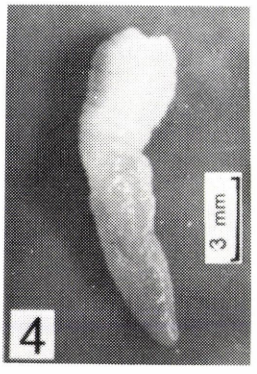
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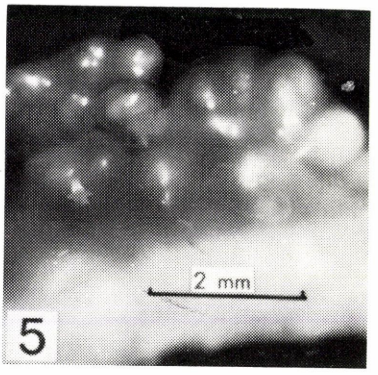
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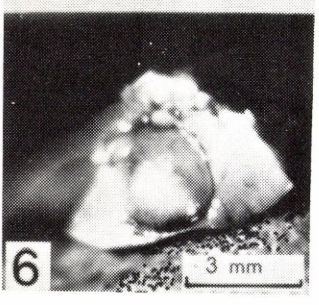
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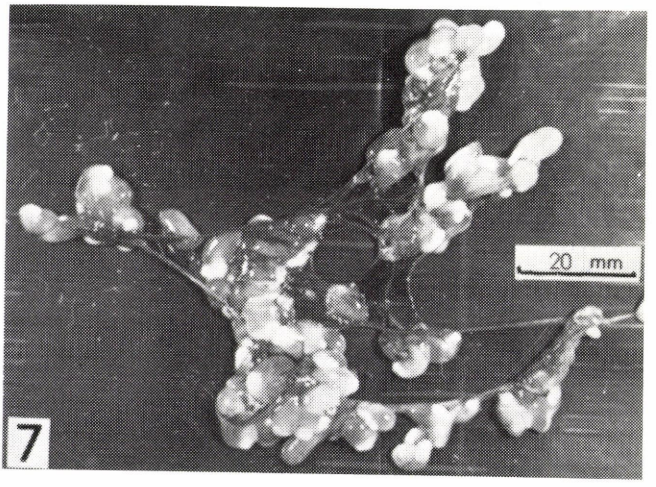
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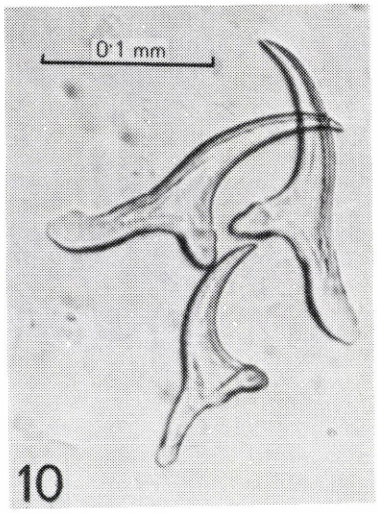
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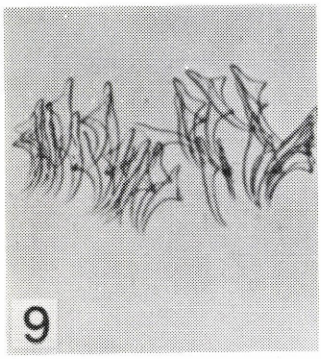
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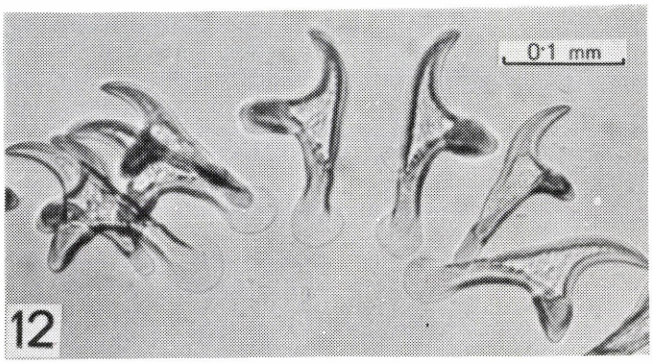
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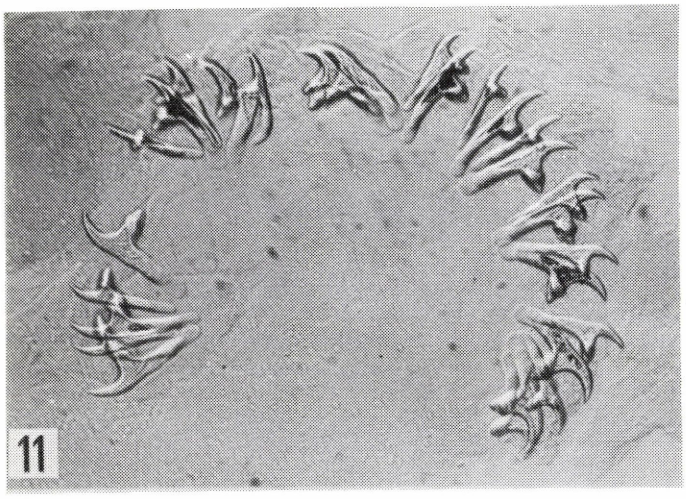
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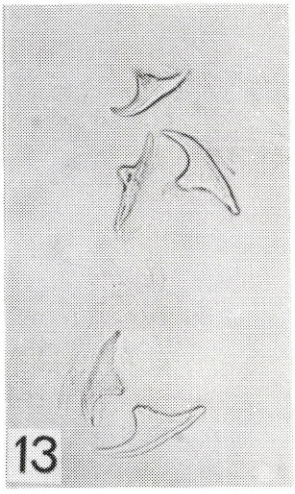
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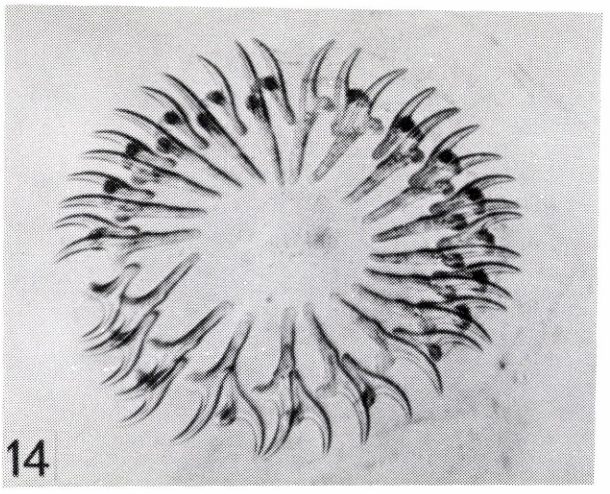
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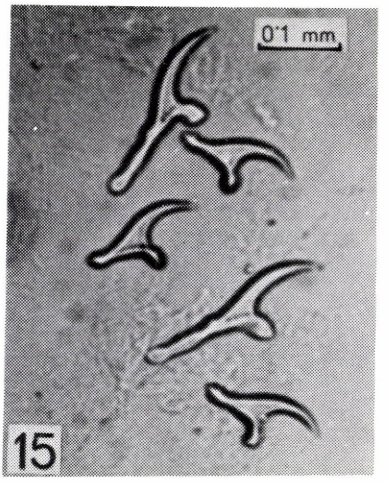

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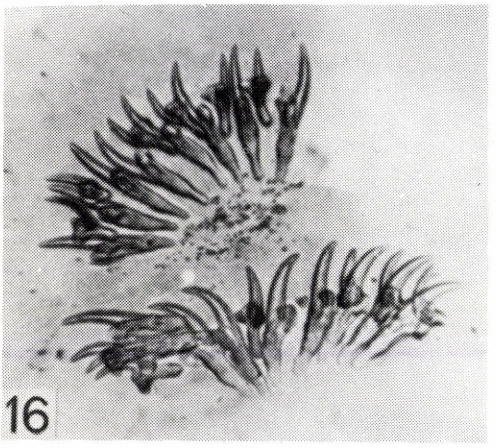
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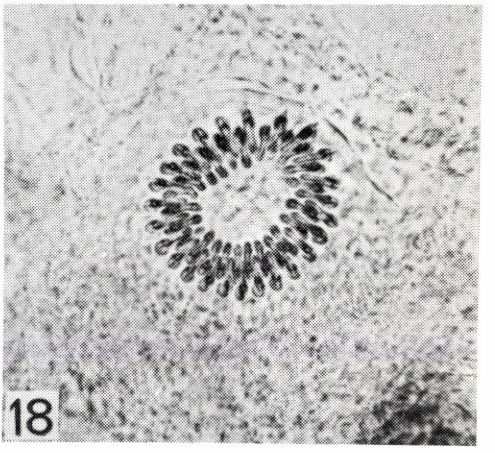
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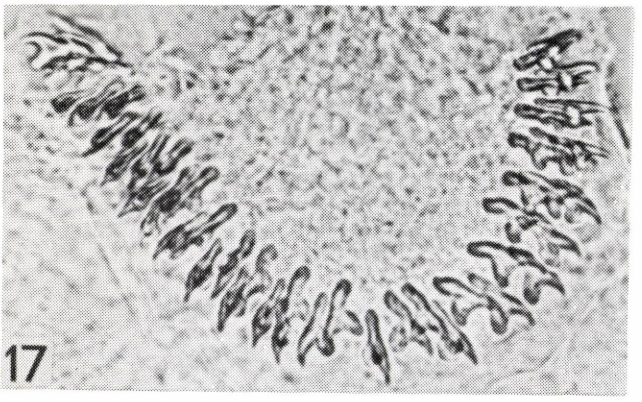
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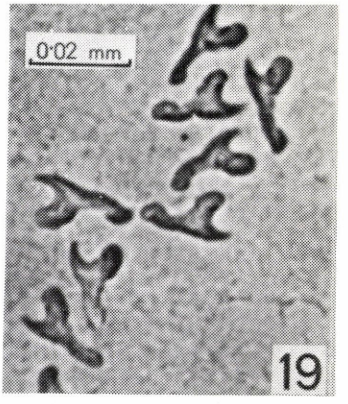

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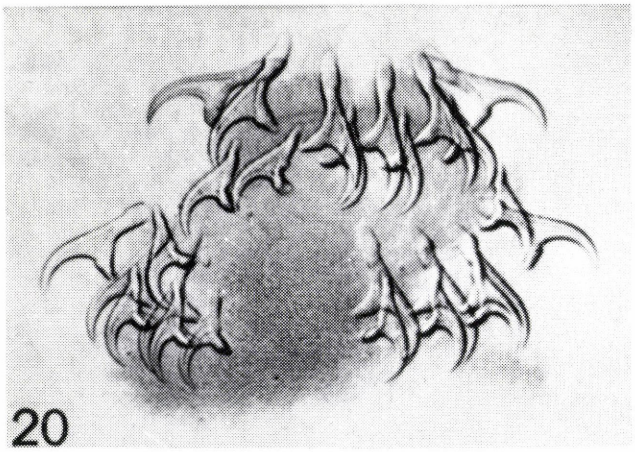

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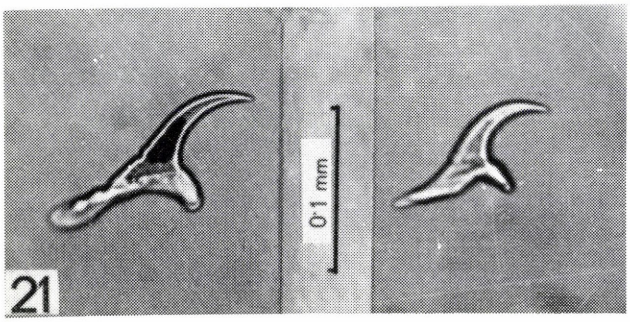

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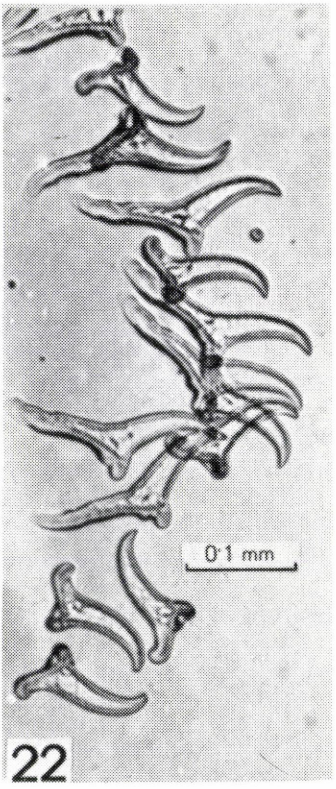

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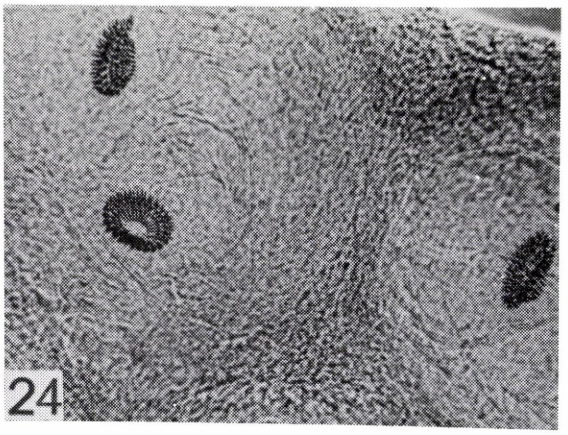
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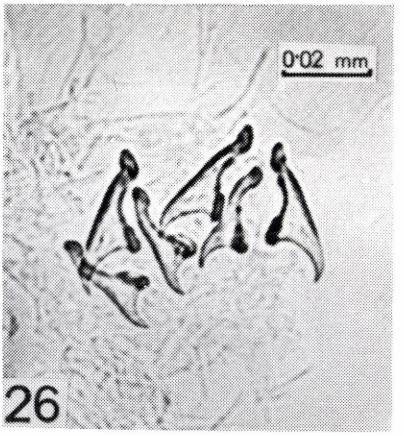

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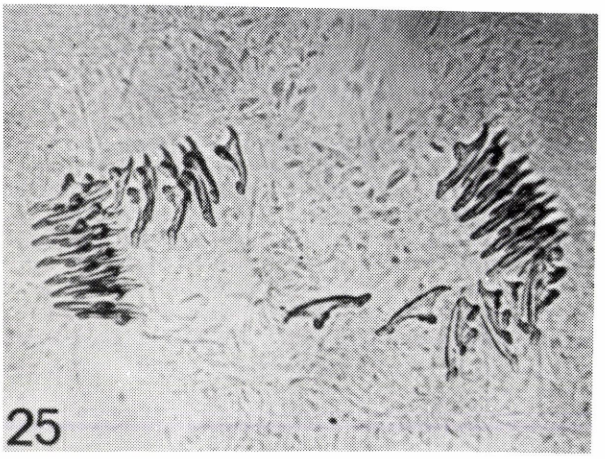
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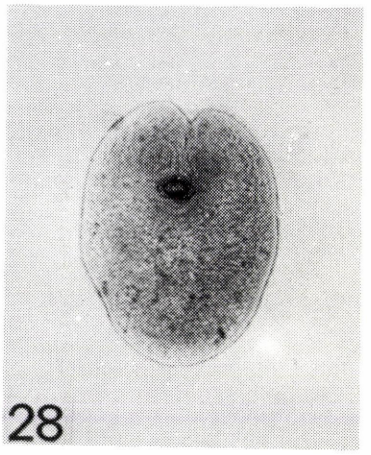
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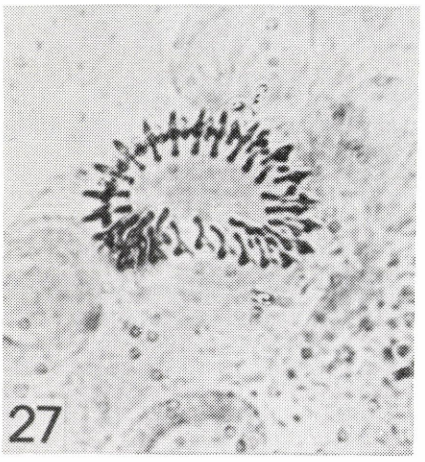
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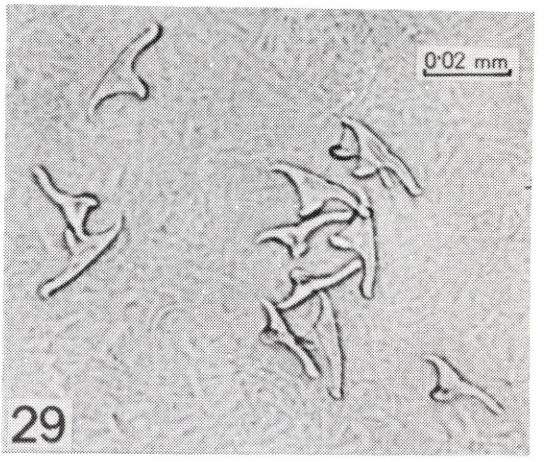

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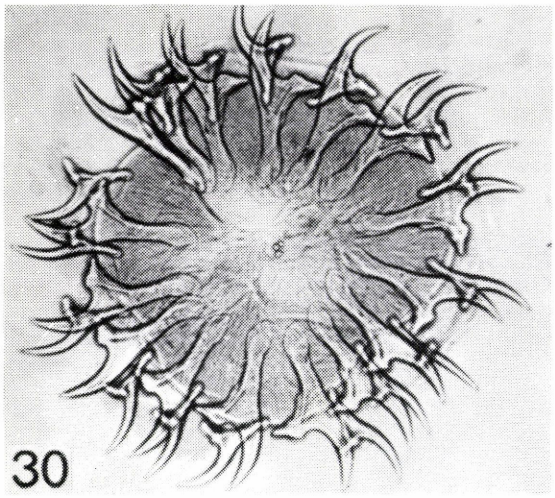
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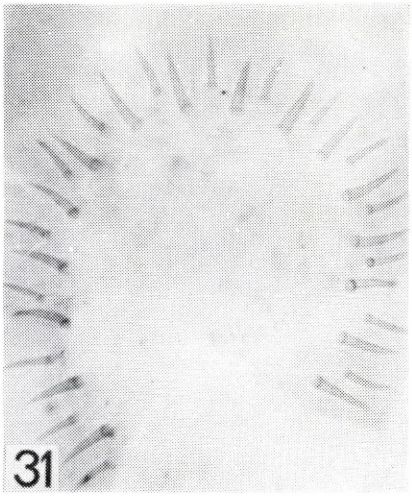
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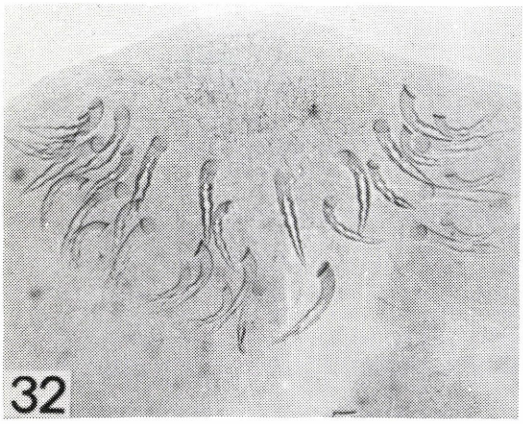
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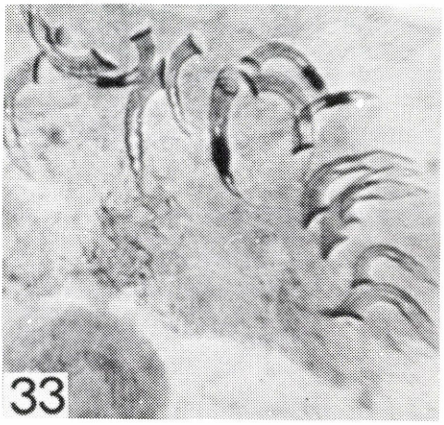
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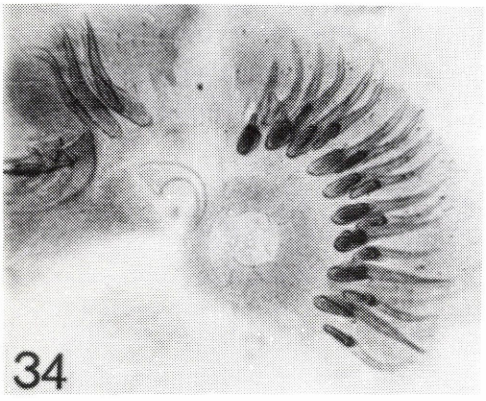
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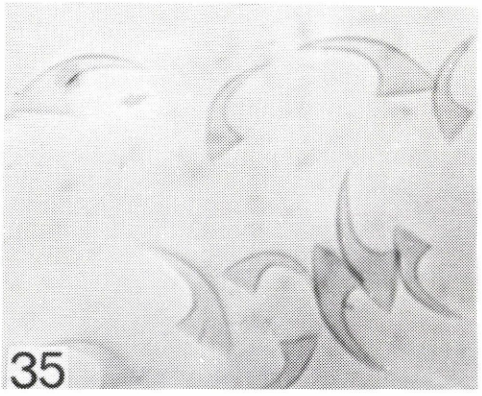
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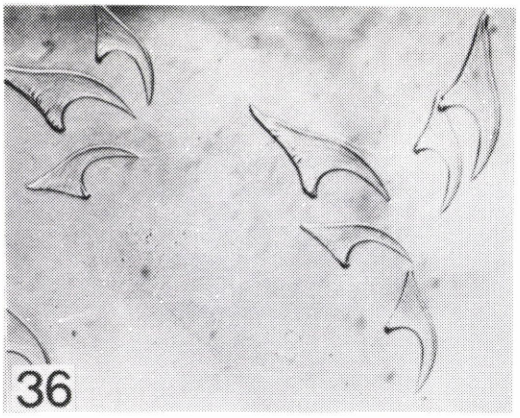
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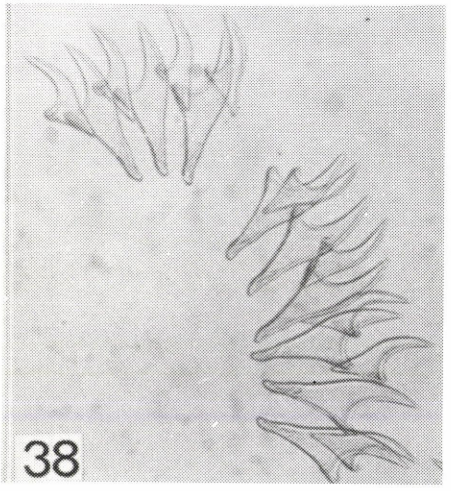
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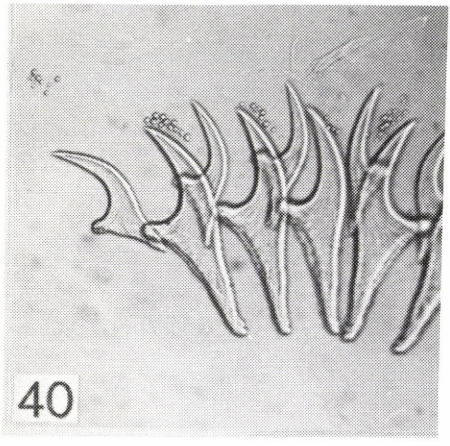
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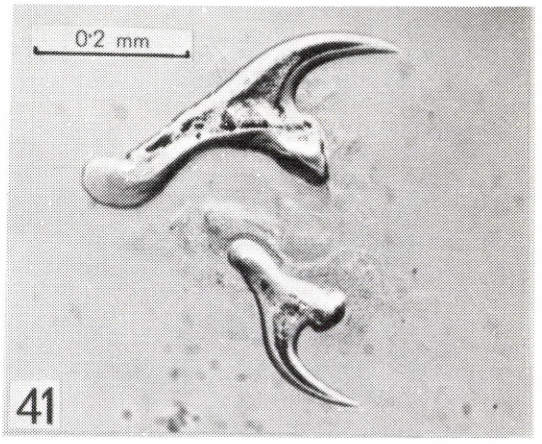
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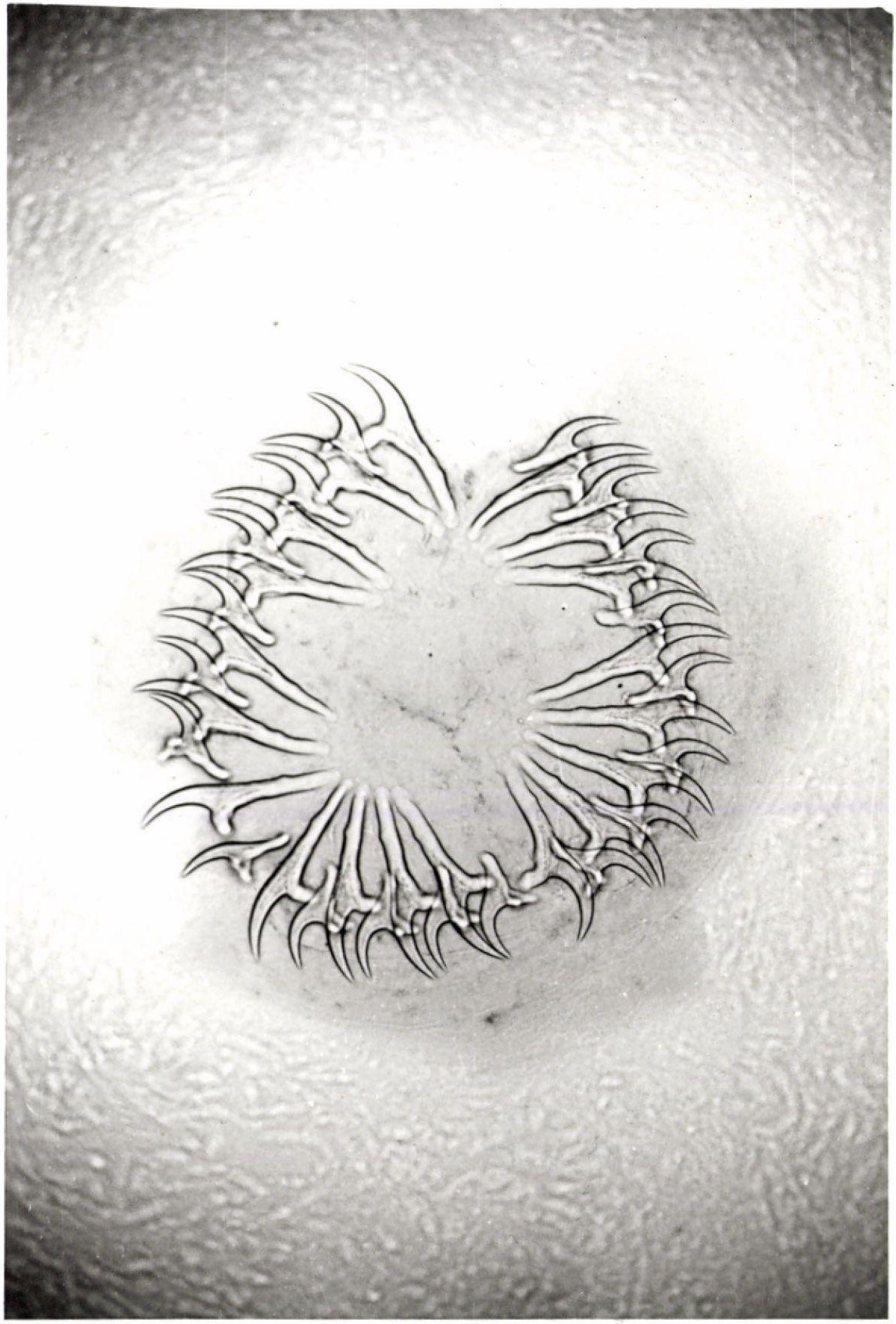

Intermediate hosts in Hungary were found among members of the families Microtidae and Cricetidae, and only one case was found in a murid species (Apodemus flavicollis), of which over 2500 specimens have been examined. The name of the larva "Cysticercus talpae" is indicative of its occurrence in the mole as intermediate host, but no infestation found in Talpa europaea Linnaeus, 1758.

Adult specimens were found in Mustela nivalis (Linnaeus, 1766) definitive host in Hungary (MURAI & TENORA, 1973, MÉSZÁROS et al., 1981).

Note. DOLLFUS (1961), ABULADZE (1964), TENORA & VANEK (1969) listed arguments in favour of the use of the name Taenia tenuicollis Rudolphi, 1819, whereas FREEMAN (1956) and VERSTER (1969) opted for the name T. mustelae Gmelin, 1780 (the debate on the nomenclature is discussed in MURAI & TENORA, 1973).

American authors (LOCKER, 1955, FREEMAN, 1956, RAUSCH, 1977) published numerous data on Taenia mustelae and its larval forms. In their material "polycephalic", "multiscolex" larvae and "coenurus like" larva cysts were often found in various intermediate hosts species infested under natural and laboratory experimental conditions (LOCKER, p. 52, FREEMAN, p. 231, RAUSCH, p. 363). In small rodents (lemming, voles) "uniscolex" larvae were more common, in musk-rats and laboratory infestations there was a definite tendency for the formation of polycephalic cysts.

In both larval and adult T. mustelae (Gmelin, 1790) Freeman, 1956 from mustelid definitive hosts, the shape of the hooks is very much like that of T. tenuicollis Rudolphi, 1819 in Hungary. The scolex in both species is arranged in two rows composed of hooks of similar shape and size. The base of the hook is somewhat shorter then its length. The size of the hooks is somewhat smaller in the North-American material than in Hungary (in Hungary 0.018-0.023, sometimes 0.025 mm; in America 0.012-0.018, normally 0.015-0.016 mm). The number of hooks showed greater variation in North America than in this study (in Hungary 43 to 58; in the North American material 40 to 65, one specimen in FREEMAN's material with 84 hooks). VERSTER (1969) noted differences in larval development in American and European material (VAHL's material from Switzerland). Because there is difference in the size of hooks, this may also be considered as further supporting evidence for the view that the "small-hooked" Taenia species from mustelids in Europa and North America represent two different species.

5. Multiceps serialis (Gervais, 1847) Stiles & Stevenson, 1905

Name of larva: Coenurus serialis Gervais, 1847.

Intermediate hosts: Lepus europaeus. - Localization: on the surface of sceletal muscles (i.e. musculus masseter). - Extensity: 1.3%. - Intensity: 1-3 coenurus bladder.

Collection data of the infested intermediate host specimens:

Lepus europaeus - County Bács-Kiskun: Bugac 01/02/66 (1), Kunbaja 28/04/73 (1); County Pest: Dabas 01/05/74 (1), Vecsés 1972 (1); County Szolnok: Jászfényszaru 15/12/75 (1) = 5 cases.

Characterization of Coenurus serialis

Coenurus bladders were found twice in the musculus masseter, twice on the surface of the thigh and once each in the abdominal cavity, on the inner musculature of the vertebral column, on the surface of the layer of connective tissue enclosing the muscles (Fig. 2). The translucent coenurus bladders are filled with liquid and characterized by endogenous and exogenous daugther bladders varying in size from 12x24 mm to 15x34 mm. On the inner and upper surface of the coenurus bladder and the endogenous daugther bladders, in fibrous capsules without pedicles are arranged several heads in rows. The number of invaginated scoleces per bladder vary from 50 to 180. The size of the capsule is 1x2 mm, diameter of the scolex 1 mm, that of the rostellum ranging from 0.30 to 0.32 mm, that of the suckers varying from 0.22 to 0.24 mm. The rostellum is armed with hooks in two rows different in size and shape (Figs 20, 21). The number of hooks vary from 28 to 32, length of the larger ones 0.152 to 0.184 mm (modal value 0.165 mm), of the smaller ones 0.099 to 0.124 mm (modal value 0.118).

According to literature data, the dfinitive host for the species is the domestic dog. No adults of Multiceps serialis have been found so far in Hungary.

Notes. The larval form corresponds morphologically with the data from the literature (ABULADZE, 1964, HALL, 1910, PARONA, 1902, VERSTER, 1969). No exact data are available for the frequency of its occurrence in Hungary, since often only the inner organs of the collected hares were presented for examination.

6. Hydatigera taeniaeformis (Batsch, 1786) Lamarck, 1816

Name of larva: Strobilocercus fasciolaris (Rudolphi, 1808).

Intermediate hosts: Ondatra zibethicus, Clethrionomys glareolus, Pitymys subterraneus, Microtus arvalis, Apodemus flavicollis, A. sylvaticus, A. microps, Mus musculus spicilegus, Rattus norvegicus. - Localization: on the liver surface. - Extensity: 24% in O. zibethicus, 0.35% in C. glareolus, 11% in P. subterraneus, 5.6% in M. arvalis, 3.8% in A. flavicollis, 1.9% in A. sylvaticus, 6.2% in A. microps, 10.9% in M. musculus spicilegus, 7.8% in R. norvegicus. - Intensity: 1-15 strobilocercus.

Localities and collection data of intermediate hosts infested by Strobilocercus fasciolaris:

Ondatra zibethicus - County Baranya: Pécs 06/12/65 (1); County Békés: Szarvas, Fishpond 06/09/71 (1), 09/11/71 (1), 14/03/72 (1), 25/05/72 (1), 15/11/72 (2), 30/11/72 (1), 07/12/72 (5), 10/01/73 (2), 23/02/73 (1), 21/03/73 (1), 24/04/73 (2); County Győr-Sopron: Fertő-tó 30/01/66 (9), 18/03/66 (8), Hanság 11/08/65 (1), Kapuvár 15/10/65 (10), 20/10/65 (2), 15/12/65 (11), 15/04/66 (6), 15/06/66 (4); County Pest: Vecsés 01/02/70 (1); County Veszprém: Ábrahámhegy 24/04/75 (1) = 72 cases.

Clethrionomys glareolus - County Heves: Kisnána, Mátra Mount. 23/03/66 (1); County Veszprém: Balatoncsicsó 26/11/68 (1) = 2 cases.

Pitymys subterraneus - County Győr-Sopron: Sopron 23/10/74 (2); County Komárom: Oroszlány 07/09/79 (1); County Veszprém: Németbánya 12/08/73 (3), Olaszfalu 04/09/79 (2) = 8 cases.

Microtus arvalis - County Bács-Kiskun: Dunapataj, Szelidi-tó 16/10/80 (2), 21/10/80 (2), 10/11/80 (6), Orgovány 07/09/71 (1); County Hajdú-Bihar: Nagyiván 09/09/76 (1); County Pest: Gödöllő, Babatpuszta 28/10/78 (9), 01/11/78 (1), 22/01/79 (2), 15/04/79 (1), 17/10/79 (3); County Vas: Bozsok 28/02/73 (2), 23/03/73 (3), 17/04/73 (3), 23/08/73 (2), 19/09/73 (4), 19/03/74 (2), 24/07/74 (1), 14/08/74 (2), 05/02/75 (1), 15/04/75 (1), 18/05/75 (1), Bük 24/03/72 (4), 27/02/73 (3), 23/03/73 (4), 17/04/73 (1), 24/05/73 (4), 03/07/73 (1), 24/08/73 (5), 19/09/73 (10), 15/11/73 (10), 18/01/74 (3), 20/03/74 (5), 06/06/74 (1), 27/06/74 (1), 24/07/74 (4), 14/08/74 (4), 26/09/74 (10), 19/11/74 (3, 08/01/75 (4), 04/02/75 (2), 04/03/75 (1), 15/04/75 (3), Jánosháza 17/07/67 (2), Meggyespuszta 13/08/68 (1), Pápoc 19/09/66 (1), 12/03/70 (1), Mersevát 17/07/67 (1), Tanakajd 24/10/66 (1), 01/11/67 (3), Tömörd 30/08/68 (1); County Veszprém: Németbánya 09/08/73 (1), Szentgál 12/07/52 (1), Vigántpetend 28/11/68 (1) = 147 cases.

Apodemus flavicollis - County Baranya: Zengővárkony 20/10/78 (1); County Bács-Kiskun: Dunapataj, Szelidi-tó 04/06/80 (1); County Fejér: Zámoly 16/10/80 (3); County Győr-Sopron: Brennbergbánya 25/04/72 (3), Sopron 23/09/71 (1); County Hajdú-Bihar: Egyek, Ohat-Forest 24/09/75 (3), 27/04/76 (1), Újszentmargita 15/05/74 (2), 23/09/75 (1); County Heves: Kisnána 25/03/66 (3), Rózsaszentmárton 15/11/71 (1); County Komárom: Mór 07/9/79 (1), Oroszlány 07/09/79 (2); County Pest: Bernecebaráti, Deszkáspuszta 03/04/67 (6), Budakeszi 09/09/66 (2), Gödöllő, Babatpuszta 30/10/78 (3); County Somogy: Mike, Halastó 13/10/77 (1), Somogycsicsó, Ágneslak 15/05/75 (1), 16/07/75 (2), 12/11/75 (1); County Tolna: Tamási 17/10/80 (2); County Vas: Bozsok 28/02/73 (1), Kőszeg 06/10/77 (1); County Veszprém: Bakonynána, Alsóperepuszta 14/07/66 (3), Balatoncsicsó 29/11/68 (2), Farkasgyepü 30/07/76 (1), Nagyvázsony 02/11/71 (2), Németbánya 02/06/67 (2), 14/04/76 (2), 25/10/79 (1), Tihany 18/06/71 (1), Tótvázsony 29/09/72 (1), Vállus 21/05/69 (1), Zirc 24/10/72 (2), 19/09/73 (1); County Zala: Zalaegerszeg 24/10/80 (2) = 64 cases.

Apodemus microps - County Pest: Gödöllő, Babatpuszta 10/04/78 (1), 28/10/78 (9), 08/01/79 (1), 15/04/79 (1), 17/10/79 (4) = 16 cases.

Apodemus sylvaticus - County Hajdú-Bihar: Tiszacsege 07/05/72 (2); County Pest: Gödöllő, Babatpuszta 31/10/78 (1); County Zala: Zajk 29/04/67 (1) = 4 cases.

Mus musculus spicilegus - County Bács-Kiskun: Ágasegyháza 17/08/77 (1), 20/10/78 (1), Fülöpháza, Kondor-tó 01/11/79 (1), 13/02/80 (1), Orgovány 09/09/71 (3); County Hajdú-Bihar: Nagyiván 09/09/76 (1); County Pest: Budapest, Csillaghegy 15/11/78 (1), Budapest, Óbuda 27/06/70 (1), Budapest, Pestlőrinc 12/03/72 (1), Budakeszi 03/05/66 (1), Érd 21/02/77 (2), Nagykovácsi 28/02/77 (1), 16/12/77 (1), 01/04/78 (1), 03/08/78 (1), 26/10/78 (4), 13/11/78 (1), 15/01/79 (1), 13/11/79 (1), 15/01/80 (1), 13/10/80 (1), 26/10/80 (1), 05/11/80 (1), 14/11/80 (1), Kosd 12/04/72 (4), Telki 04/05/66 (1); County Vas: Bük 24/05/73 (1), Tanakajd 20/09/72 (1); County Veszprém: Balatoncsicsó 19/05/70 (1), Nagyvázsony 22/05/70 (2), Németbánya 26/07/76 (1) = 41 cases.

Rattus norvegicus - County Győr-Sopron: Balf 22/04/71 = 1 case.

Characterization of the larval Hydatigera taeniaeformis

Strobilocercus fasciolaris is situated always on the liver surface. The host-cysts are yellowish-white, globular to ovoid, about the size of 5-12 mm. In the host-cyst the larva freely coils up, 50-150 mm in length and 1-3 mm in width. The form of strobilocercus characterized by a pseudosegmented body, on the anterior end with a scolex identical to that of the adult worm, on the posterior end with a bladder 2-4 mm in diameter. The scolex is protruded (in the fully developed larva) or invaginated (young larva), 1-1.3 mm in diameter. The rostellum is 0.6, the suckers are 0.56 mm in diameter. Rostellar hooks 30 to 36 in number situated in two circles. Large hooks 0.420-0.456 mm (modal value 0.430 mm), the small ones 0.250-0.288 mm (modal value 0.272 mm) in length. The shape of fully developed hooks illustrated in Figures 30 and 41.

In the first report on taeniids in Hungary (MURAI & TENORA, 1973) we noted the presence of two forms of uncertain specific identity (Cysticercus sp. I, and Cysticercus sp. II) parasitizing Mus musculus spicilegus and Microtus arvalis. Several forms similar to these have been found in rodents in Afghanistan by TENORA & KULMAN (1969). I have succeeded in finding a number of very young cysticerci in the Taeniidae material collected up to 1980, and I have come to the conclusion that these forms represent nothing but the very earliest developmental stages of Hydatigera taeniaeformis.

The youngest forms of Strobilocercus fasciolaris are free-lying cysticerci enclosed in translucent host-cysts, on the surface of the liver, 1-3 mm in diameter. The cysticercus at this stage is globular, the wall of the bladder possesses a scolex invaginated towards the lumen. Its diameter is 0.3 mm. The 29-36 soft hooks are in the beginning awl-shaped, latter sickle-shaped. At this stage on the rostellum large numbers of acicular very fine and short to punctiform chitinous formations are present, which disappear with the development of the larva. These chitinous formations first seemed to indicate very young hooks and we (MURAI & TENORA, 1973) thought that we were dealing with a Joyeuxiella species, but I exclude this possibility now.

Young larvae of H. taeniaeformis have been found in the following number of intermediate hosts: 12 Microtus arvalis, 8 Apodemus flavicollis and 6 Mus musculus spicilegus. The hooks (or hook formations) are arranged in two rows even in the youngest larvae, with those of the outer row being smaller. The shape and size of the hooks vary according to the following scheme:

A) Awl-shaped hook formations (Cysticercus sp. II. in MURAI & TENORA, 1973) - length of large and small hooks in mm, respectively: 0.075 and 0.060, 0.120 and 0.095, 0.160 and 0.136 (Figs 31-33).

B) Sickle-shaped hooks (Cysticercus sp. I. in MURAI & TENORA, 1973): 0.210 and 0.165, 0.235 and 0.128, 0.250 and 0.185 (Figs 34-36).

C) Diameter of host-cyst up to 5 mm, with the hooks gradually developing a guard and a handle: 0.310 and 0.210, 0.370 and 0.240, 0.390 and 0.250 in size (Figs 37-40).

D) Developed hooks (0.430 and 0.270) were found in cysts at least 8 mm in diameter. The body of the strobilocercus larva is elongated, with well-discernible pseudosegmentation and posterior bladder. The body of the larva continous growing after development of the scolex.

The larva of Hydatigera taeniaeformis is the most common taeniid parasite of rodents in Hungary; it occurs equally in microtids and murids. This species was found in all samples which consisted of at least 50 examined small mammals. NECHAY (1973) studied the infestation of Microtus arvalis by H. taeniaeformis in the Fejér, Heves, Nógrád, Pest and Vas counties and found an infestation rate of 7.2%. It occurs in laboratory rodents as well by spontaneous infestation (see MURAI & TENORA, 1973).

Massive infestation by H. taeniaeformis may lead to the death of the intermediate host by severely damaging the liver during its invasion (NECHAY, 1973). Developed larvae are apparently indifferent to the host rodents.

Data so far indicate that the definitive host of this species are the domestic and the wild cat, which may be severely infested (MURAI & TENORA, 1973, MURAI & SUGÁR, 1976).

7. Tetratirotaenia polyacantha (Leuckart, 1856) Abuladze, 1964

Name of larva: Armatetrathyridium polyacantha (Leuckart, 1856).

Intermediate hosts: Ondatra zibethicus, Clethrionomys glareolus, Microtus arvalis. - Localization: body cavity (c. abdominalis). - Extensity: 0.33% in O. zibethicus, 0.36% in C. glareolus and 0.07% M. arvalis. - Intensity: 1-20 specimens.

Collection data of the infested intermediate hosts:

Ondatra zibethicus - County Győr-Sopron: Kapuvár 20/10/65 (leg. O. SEY) = 1 case.

Clethrionomys glareolus - County Borsod-Abaúj-Zemplén: Lillafüred 04/06/30 (leg.I.VÁSÁRHELYI) (1); County Zala: Zajk 29/04/67 (1) = 2 cases.

Microtus arvalis - County Vas: Bozsok 17/10/74 (1), 07/01/75 (1) = 2 cases.

Characterization of the larval Tetratirotaenia polyacantha

Armatetrathyridium polyacantha larvae are situated freely in the peritoneal, rarely in the thoracic cavity, and are oval, sometimes drop-shaped or elongated (Fig. 4). Length of the body is 4 to 12 mm, width varies between 2.5 and 4 mm. The non-encysted larva is actually built up in a similar way to the cysticercus of Taenia species. The larval bladder has a wall wrinkled to various extents, with an infolding at the anterior portion, and a scolex similar to that of adult worm is found in the anterior third of the larva. Diameter of scolex 0.75 mm, that of rostellum 0.50 mm, those of suckers 0.25 mm. The rostellum contains 55 to 66 characteristically shaped hooks arranged in two rows (Fig. 23). Smaller hooks vary in length from 0.120 to 0.143, the larger from 0.178 to 0.221 mm.

The larval form of T. polyacantha was rare in the examined material. Intermediate hosts were found only in member of the Microtidae family. Adult specimens have been collected from the definitive host, Vulpes vulpes (Linnaeus, 1758) (MURAI & TENORA, 1973). According to literature data the range of intermediate hosts is larger (ABULADZE mentions members of the families Muridae and Cricetidae).

Note. ABULADZE (1964) erected a new genus to accomodate the species T. polyacantha, based especially on the larval form and named it "armatetrathyridium". This larval form shows great resemblance to the larval form of Taenia martis (both being situated freely in the body cavity). The number of hooks in T. polyacantha (55-66 in contrast with 28-42 of the other species) is not a generic character, since e.g. T. tenuicollis possesses over 50 hooks. The shape of the smaller hooks is different from those of the other taeniid species (Fig. 22), since they have very small handles. VERSTER (1969) rejects the validity of the genus Tetratirotaenia Abuladze, 1964, whereas others have repeatedly used this name (TENORA, WIGER, SHARPILO, etc). It must also be noted that if the validity of the genus Tetratirotaenia was proved, than the species Taenia martis (Zeder, 1803) should also be referred here.

8. Cladotaenia globifera (Batsch, 1786) Cohn, 1901

Name of larva: Cladothyridium globifera (Batsch, 1786) Abuladze, 1964.

Intermediate hosts: Clethrionomys glareolus, Apodemus flavicollis, Apodemus microps, Apodemus agrarius. - Localization: surface of liver, usually at the edges. - Extensity: 0.36% in C. glareolus, 0.98% in A. flavicollis, 1.54% in A. microps, 0.5% in A. agrarius. - Intensity: 50 to 500 host-cysts.

Collection data of the infested intermediate hosts:

Clethrionomys glareolus - County Győr-Sopron: Sopron 28/08/70 (1); County Zala: Zajk 29/04/67 (1) = 2 cases.

Apodemus flavicollis - County Hajdú-Bihar: Hajdúbagos 29/09/66 (1); County Pest: Bernecebaráti, Deszkáspuszta 01/04/67 (1), Gödöllő, Babatpuszta 28/10/78 (3), 18/01/79 (2), 14/04/79 (1); County Somogy: Somogyszob, Baláta-tó 03/08/70 (3); County Vas: Alsóújlak 06/10/77 (1), Őriszentpéter 20/06/67 (1), Vát 04/10/77 (1); County Veszprém: Németbánya 13/08/73 (1), 23/10/79 (1) = 16 cases.

Apodemus microps - County Pest: Gödöllő, Babatpuszta 28/10/78 (2), 18/01/79 (1), 21/05/80 (1) = 4 cases.

Apodemus agrarius - County Somogy: Somogycsicsó, Ágneslak 11/11/75 = 1 case.

Characterization of Cladothyridium globifera

C. globifera larvae are not uncommon in Apodemus species, where they are usually situated at the edges of the hepatic lobes in strong-walled opaque cysts arranged bead-like around the liver (Fig. 5). One host cyst usually contains more than one larva (maximum noted: 11). The oval or globular host-cysts vary in diameter from 0.5 to 0.8 mm. The cysticercus-type larvae 0.5 to 0.7 mm length usually containe inverted - or protruded - scoleces with a diameter ranging from 0.2 to 0.3 mm. The same measurements for the rostellum is 0.09 mm, for the suckers 0.08 mm. The rostellum is arranged in two rows of 39-49 characteristically shaped hooks (Figs. 24-26). The smaller of these hooks vary in length from 0.022 to 0.027 mm, the larger from 0.034 to 0.037 mm.

Adult specimens of the species were found in Buteo buteo (Linnaeus, 1758), B. lagopus (Pontoppidan, 1763), Circus aeruginosus (Linnaeus, 1758) and C. macrourus (Gmelin, 1771) hosts in the Bakony Mountains and in the Hortobágy National Park (MURAI & TENORA, 1973, MURAI et al., in press).

Note. MARKOWSKI (1928) observed 1-3 larvae in host-cysts of a Cladotaenia species. FREEMAN (1959) summarized the data for the genus available till that time and keyed the species on the base of a number of characters. ABULADZE (1964) considered the larval form to be of diagnostic importance for differentiating taeniid species and name it Cladothyridium. It must be noted that in those Cladotaenia host-cysts which contained more than one larva, the larvae were situated besides one another, lying freely. Multiscolex form, or the formation of daughter bladder was not observed.

9. Cladotaenia circi Yamaguti, 1935

Name of larva: Cladothyridium circi (Yamaguti, 1935) Abuladze, 1964.

Intermediate hosts: Clethrionomys glareolus, Microtus arvalis. - Localization: on the liver and the pulmonal surface. - Extensity: 0.18% in C. glareolus, 0.04% in M. arvalis. - Intensity: 5 to 50 host-cysts.

Collection data of the infested intermediate hosts:
Clethrionomys glareolus - County Vas: Őriszentpéter 20/06/67 = 1 case.
Microtus arvalis - County Vas: Bük 26/06/74 = 1 case.

Characterization of Cladothyridium circi

During the course of examining small rodents, only two cases of larval infestation were found where the occurrence of C. circi could be ascertained on the basis of the shape and size of the hooks. Few cysts were found in the liver of a Clethrionomys glareolus and a massive infection was found in a Microtus arvalis, where not only the liver, but also the lungs contained large number of cladothyridia. The cysts were situated mainly at the edges of the lobes of the liver and the lungs. The diameter of the oval cysts ranged from 0.8 to 1.0 mm, the larvae were freely placed in the translucent cysts with strong walls (pergament-like membrane of connective tissue). The length of the cysticercus-type larvae vary from 0.6x0.4 mm to 0.6x0.5 mm. The larvae usually have invaginated but sometimes also everted scoleces, often 2-3 larvae in a host-cyst. Diameter of the scolex is 0.3 mm, that of the rostellum 0.08 to 0.10 mm, same for the suckers is 0.07 mm. The rostellum is arranged in two rows, with 47 to 52 hooks of different sizes and shapes. The smaller hooks vary in length from 0.018 to 0.020 mm, the larger ones vary from 0.023 to 0.026 mm. The shape of the hooks is unmistakebly different from those of the T. tenuicollis, which are similar in size (see photographs on Figs 27-29).

Adult specimens of the species were collected from Falco peregrinus Tunstall, 1777 in the Hortobágy National Park (MURAI et al., in press).

DISCUSSION

Collecting data in the course of fifteen years on the infestation of rodents and lagomorphs in Hungary by taeniids led to the following conclusions.

The larval forms of all species have been found (Table 1) that had been expected from Central Europe and from the species of carnivores known to occur in Hungary. The study material was sufficiently large for faunistical study, though some of the intermediate hosts have been collected systematically only from about half of the area of Hungary (Table 2): 80% of the rodents originated from Győr-Sopron, Bács-Kiskun, Pest, Vas and Veszprém counties; lagomorphs were examined mainly in Heves, Pest and Bács-Kiskun counties.

Hares and rabbits of the studied regions were generally heavily infested with larvae of Taenia pisiformis. The larval form of Multiceps serialis was found in the Great Hungarian Plain only, though it must be admitted that most of the study material originated from this region (Table 3). The most important definitive host for Taenia pisiformis is the domestic dog; stray dogs and hunting hounds sustain the Cysticercus pisiformis infestation of the hare population.

The larva of Hydatigera taeniaeformis is the most common parasite of rodents, its definitive host is the domestic and the wild cat. Of these two, the domestic cat is present all over Hungary. The field vole and the house mouse are the most important of the nine intermediate host species. Remarkably high is the infestation rate of the musk-rat in the study material. NECHAY (1973) assumed that, apart from felids, other carnivores were also responsible for dispersing this species, but there are no conclusive data to prove this.

Larval form of Taenia crassiceps and Tetratirotaenia polyacantha, for both the red fox being the definitive host, were found only in microtid species in Hungary.

Larvae of Taenia martis were found in one locality only, in Apodemus flavicollis and Clethrionomys glareolus intermediate hosts inhabiting closed-canopy forests of the Börzsöny mountains (County Pest). The adult helminth was found in a Martes foina definitive host in the Mátra mountains (County Heves). The beech marten and the stone marten are now protected by law in Hungary, but their populations have been seriously depleted a few years ago. Probably that is the reason for the very rare occurrence of this species in the intermediate hosts. Few specimens have been examined from the Northern Highlands, but its occurrence is expected. The absence of the species in the Bakony mountains is surprising (County Veszprém), since 1022 small mammals have been dissected for parasitological examination.

The larval forms of Taenia tenuicollis have been found in voles (5 microtid species), in the hamster (Cricetidae), and in one case in the yellow-necked field mouse (Muridae). It was found in all samples in which the number of microtids or hamsters exceeded one hundred. An average 8% infestation rate of its definitive host, the weasel (Mustela nivalis) indicates that it lives in relative freedom in these regions.

Of the Cladotaenia species connected to raptorial definitive hosts (Falconiformes), C. globifera occurred especially in murids (Apodemus flavicollis, A. microps and A. agrarius), and in bank voles (Clethrionomys glareolus). The intermediate hosts for the C. circi are voles Microtus arvalis and Clethrionomys glareolus. It is worthwhile to mention that, apart from its liver, this species also occurred in the lungs of the intermediate host.

Morphological and taxonomical problems connected with the larval forms of the various taeniid species have been dealt with under the notes on the species.

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